Section:______ **Name:** ______________________________ April 9, 2026

Linear Algebra and Differential Equations Tutorial
Quiz 9

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1. (2 points) For the following two ordinary differential equations, determine the order and whether the equation is linear.

(a) $y' = xy$

(b) $\frac{dy}{dx} - xy^2 = 0$

Solution:

(a) Order 1 and linear.

(b) Order 1 and not linear (because of the y^2).

2. (2 points) Choose one of the previous two equations and solve the initial value problem with condition $y(1) = 2$.

Solution:

(a) Either via separable equation or linear (integrating factor). Let's do it using integrating factor. Rewrite in standard form $y' - xy = 0$, so $P(x) = -x$ and $Q(x) = 0$. The integrating factor is

$$\mu = e^{\int P(x)dx} = e^{-\frac{1}{2}x^2}.$$

The general solution is then

$$y = \frac{1}{\mu}\left[\int \mu Q(x)dx\right] = e^{\frac{1}{2}x^2}\left[\int 0\,dx\right] = Ce^{\frac{1}{2}x^2}.$$

Using the initial condition,

$$2 = y(1) = Ce^{\frac{1}{2}} \implies C = 2e^{-\frac{1}{2}}.$$

The particular solution is:

$$y = 2e^{\frac{1}{2}(x^2-1)}$$

(b) Separate the variables and integrate:

$$\frac{1}{y^2}dy = x\,dx \implies \int \frac{1}{y^2}dy = \int x\,dx \implies -\frac{1}{y} = \frac{1}{2}x^2 + C.$$

By the initial value,

$$-\frac{1}{2} = \frac{1}{2}(1) + C \implies C = -1.$$

Hence,

$$-\frac{1}{y} = \frac{1}{2}x^2 - 1 = \frac{1}{2}(x^2-2) \implies y = -\frac{2}{x^2-2}.$$

Problem	Score
1	/ 2
2	/ 2
Total	/ 4